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Name of Candidate: **Nripendra Kumar Singh**
Name of Supervisor: **Dr Khalid Raza**
Name of the Department: Computer Science
Faculty: Faculty of Sciences
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Abstract

In recent years, the field of deep learning has witnessed remarkable progress and revolutionized various domains, including computer vision, natural language processing, and healthcare. The main goal of this thesis is to explore the role of a deep learning approach in dental radiology image analysis and optimize a deep learning model for the automatic interpretation of complex clinical findings in dental radiography. To gain insights into recent advancements in dental image analysis, we conducted a comprehensive systematic literature review (SLR). From the extensive PubMed repository, we carefully shortlisted over 75 relevant articles published between 2016 and 2020 (spanning five years) that employed deep learning approaches for dental image segmentation, object detection, classification, and other related image processing tasks. Our first objective is to evaluate the segmentation of the entire dental anatomy in the panoramic image by implementing the custom deep CNN architecture. Detection of tooth saliency is an open problem in the complex dental radiograph. In this work, a new architecture of the deep learning model, TeethU2Net, is proposed for state-of-art tooth saliency detection in dental panoramic radiographs (DPR) image. The proposed approach achieved an accuracy of 0.9740, specificity of 0.9969, precision of 0.9880, recall of 0.8707, and F1-score of 0.9047. The second objective is detection of treatment types in dental panoramic radiographs. In this work, we optimized a single-stage anchor-free deep learning model, BBAVector to detect and classify the teeth with or without treatment. The proposed work performance on overall dental treatment detection with an average precision (AP) of 85%. The result of this study suggested that RCT was recognized and predicted with the highest accuracy of 91% AP score.

Our final objective to investigate the recognition of multiple dental treatment and diagnosis conditions in full scan panoramic image. Detection of specific abnormality with intact dentition on a DPR image is a challenging task due to the complexity and diversity of the grey distribution. We introduce a deep learning framework called DTDNet is two-stage training approach achieving an average precision (AP) of 0.87. Moreover, the classification of treatment and diagnosis categories was performed with an overall accuracy of 0.9371 and a weighted F1 score of 0.9376.

In addition, we highlighted the potential obstacles and future prospects of deep learning methods in dental radiology image analysis that facilitate more precise clinical diagnoses.